MASTER OF PUBLIC HEALTH

A cooperative Program of

JOHNS HOPKINS BLOOMBERG SCHOOL OF PUBLIC HEALTH
&
The IIHMR University

Practicum Training at Primary Health Center, DADHIYA

By

Dr. Shubham Maheshwari

IIHMR/JHSPH MPH

2013-2015

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At

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Prevalence of stunting and associated factors among under 5 children at rural north eastern Rajasthan: a community based cross sectional study.

By

Dr. Shubham Maheshwari

Under the guidance of

Dr. P.R.Sodani

Year 2013-2015

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TO WHOMSOEVER IT MAY CONCERN

This is to certify that Dr. Shubham Maheshwari student of Master of Public Health Program offered by Institute of Health Management Research: Jaipur in cooperation with Johns Hopkins Bloomberg School of Public Health, Baltimore has undergone Practicum Training at Primary Health Center, DADHYA on the topic Prevalence of stunting and associated factors among under 5 children at rural north eastern Rajasthan: a community based cross sectional study. From November 2014 to February 2015. The Candidate has successfully carried out the study designated to him during practicum training and his/her approach to the study has been sincere, scientific and analytical.

The Practicum Training is in fulfillment of the course requirements.

I wish him all success in all his future endeavors.

Dean, Academics and Student Affair (IIHMR Jaipur)	**Dr. P.R.Sodani (IIHMR Jaipur / JHSPH Baltimore)**	**Dr. Jitendra Ahuja (PHC, DADHIYA)**

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CERTIFICATE BY SCHOLAR

This is to certify that the Practicum Project titled **Prevalence of stunting and associated factors among under 5 children at rural north eastern Rajasthan: a community based cross sectional study** and submitted by Dr. Shubham Maheshwari Enrolment No 9 under the supervision of Dr. P.R.Sodani for award of **Master of Public Health** carried out during the period from November 2014 to February 2015 embodies my original work and has not formed the basis for the award of any degree, diploma associate ship, fellowship, titles in this or any other Institute or other similar institution of higher learning.

Signature

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This study is dedicated to all policy makers who endeavor day in and out towards bettering the lives of mothers, children and all those seeking health care services and acknowledge that countless lives have been saved by their unselfish efforts.

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ABBREVATIONS-

1. ANC- Antenatal Care.
2. BMI- Body Mass Index.
3. CHC- Community Health Centers.
4. CDC- Center for Disease and Preventions.
5. DHS- Directorate of Health Services.
6. EBF- Exclusive Breast Feeding.
7. LHV- Lady Health Visitor.
8. NFHS- National Family Health Survey.
9. PHC- Primary Health Centers.
10. PNC- Post Natal Care.
11. TB- Tuberculosis.
12. UNDP- United Nations Development Program.
13. UNICEF- United Nations Children Fund.
14. WHO- World Health Organization.

INTRODUCTION-

Worldwide, ten and a half million children of age under-five die every year, with 98% of these deaths reported to occur in developing countries (UNICEF, 2007). In recognition of the burden of malnutrition among under-five children, four of the eight United Nations' Millennium Development Goals (MDGs) are specifically directed towards improving child health outcomes in developing countries. It produces serious health, social and economic consequences throughout the life course [1–3] as well as across generations [4], making it the leading risk factor among children under five worldwide [5]. In particular, a reduction in the mortality of children is a key MDG, and a reduction in malnourishment among children is an important indicator of progress towards that goal. In India, like many developing countries, the most common nutritional problems in infancy and early childhood are stunting, wasting; iron-deficiency anaemia, poverty and low birth weight [6, 7]. Malnutrition during the first 2 years of life can lead to mortality and morbidity in childhood [8, 9] and is one of the most preventable risk factors for mortality [10]. Development efforts have brought major changes in India over the last decades (UNDP, 2005), yet the nutritional situation of women and children in the country is still of great concern. For instance, nationally more than 48%, 19.8% and 42.5% of under-5 children were stunted, wasted and underweight respectively (NFHS-3) [11]. Madhya Pradesh (55%), Bihar (54%), Orissa (54%), Uttar Pradesh (52%) and Rajasthan (51%) are respectively shown highest prevalence of malnutrition states in India [11]. Low height-for-age or stunting reflects a failure to reach linear growth potential, and is a key indicator of chronic under nutrition. Globally, depending on the precise definition and estimate used, between 171 million [14, 15] and 314 million [16] children under five are currently classified as stunted, with 90% of this burden occurring in 36 African and Asian countries [12]. Between 1985 and 2011 the prevalence of moderate-to-severe stunting has declined from 47% to 30% [15], but progress has

been highly uneven, and stunting rates in the most affected world regions have largely remained static [15,16]. To date, most of the large-scale programmes to address stunting have fallen behind expectations. Systematic reviews of the effectiveness of some of the major nutrition interventions, such as promotion of breastfeeding [18], promotion of complementary feeding through education or food provision [13,19–20], and supplementation with single or multiple nutrients [21,22] usually show significant impacts on behaviour but modest and context dependent impacts on height gain or stunting prevalence [23]. Moreover, few children in the developing world currently benefit from optimal breastfeeding practices, as well as sufficient dietary diversity and meal frequency [14]. In contrast, the history of most industrialized countries suggests that virtually all stunting can be averted, making the failure to make rapid progress all the more disconcerting. Therefore, it is essential to revisit the assumptions that underlie current intervention practices. It is broadly accepted that child stunting is the outcome of multiple risk factors. Nevertheless, much of the modelling to assess presumed cause-effect relationships in observational epidemiology and effectiveness research tends to reduce this complex interplay of risk factors through focusing on single risks and interventions. The recent emphasis on the relevance of systems approaches in epidemiology [24–28] implies, however, that the determinants of stunting must be examined in their entirety, if we do not want to risk incorrect estimates of risk factors and interventions as a result of oversimplifications in modelling approaches.

The optimal growth and development of infants and young children are fundamental for their future. Stunting (i.e., low height-for-age) is one of the most important public health problems in developing countries, including India. Stunting shows poor linear growth accumulated during the prenatal and postnatal periods. It is related to mental capacity, school performance and working

capacity in the adult period [29]. It is a major health problem in South Asia where half of the children aged less than five years are stunted. Stunting in childhood include increased behaviour problems, increase susceptibility to infectious diseases, absent intellectual ability [30]. Studies consistently show that mother's nutritional status, child's sex, parental education, poverty, and socio-economic status, place of residence, child care behaviour, cultural beliefs, and access to health care and environmental ecosystems are important factors associated with stunting [31]. Most studies conducted on African settings emphasise the importance of maternal education [32], provision of household water and sanitation services and household wealth or income [33]. Studies in developing countries like Bangladesh children show strong inverse relationship between household wealth inequality and children's chronic under-nutrition [34, 35]. Although a number of studies emphasise household wealth and nutritional status of children, the relationship between economic inequality and a child's nutritional status is not conclusive. For instance, studies conducted elsewhere do not find a consistent relationship between wealth and child malnutrition [36], while acute under-nutrition among children was reported to be significantly associated with a mother's feeding practices, parent's health-seeking behaviour and personal hygiene [37]. Despite significant progress in the nutritional status, a large proportion of mother and children are still malnourished in India. While studies on nutritional status of under-five children in other developing countries are enormous same as shown in rural India where mainly vast majority of people lives as socio-economic correlates of under-nutrition. This study aims to explore the socio-economic determinants of stunting among under-five children of rural India. The findings may improve understanding of the prevalence and risk factors that are essential in order for better design and implementation of nutritional interventions to reduce child mortality and morbidity in India.

LITERATURE REVIEW

The global burden of stunting far exceeds that of underweight, with 130 million children under five years of age being considered as underweight, as against approximately 195 million being stunted in the developing world. Many countries display far higher rates of stunting prevalence than underweight prevalence in children, making it an important public health issue. In the report2 "Tracking progress on child and maternal nutrition – A survival and development priority", UNICEF states that, "Governments, donors and partners that consider only underweight prevalence are overlooking a significant portion of the persistent problem of undernutrition. The high stunting burden in many countries should be an issue of great concern." This is further emphasized in the United Nations Standing Committee on Nutrition's review paper on stunting: "Stunting in children below the age of five is a stronger indicator of hunger and of one of its determinants, poverty, than other anthropometric indicators or estimates of per capita income. This is because stunting indicates the chronic restriction of a child's potential growth, reflecting the cumulative effects of inadequate food intake and poor health conditions that result from endemic poverty."2

Stunting is referred to as being low-height-for-age (HAZ), less than minus two standard deviations (SD) of the new WHO Growth Standard, as it indicates a process of failure to reach linear growth potential as a result of insignificant nutrition conditions. On a population basis, poor socioeconomic conditions shows high levels of stunting and an increased risk of illness or inappropriate feeding practices which shows frequent and early exposure to adverse conditions. Similarly, if we look out decrease in the national stunting rate which also indicate of improvements in the overall socioeconomic conditions of a country. The worldwide variation of

5% to 65% among the less-developed countries shows highest prevalence of stunting. In developing countries, the prevalence of stunting starts to rise at about three months of age and then slows at around two years of age. This highlights the fact that age modifies the interpretation of the findings: For children in the age group below two to three years, low height-for-age probably reflects a continuing process of failing to grow; for older children, it reflects a state of having failed to grow. This is an important difference when one is planning interventions to address stunting and further emphasizes the critical window of opportunity that exists for optimal nutrition from preconception to two years.

Early detection and intervention is critical: Most growth retardation occurs very early in life. The two periods of greatest vulnerability to stunting are during intrauterine development, and during the transition from the reliance on breast milk to the addition of complementary food that generally begins in the second six months of life. Studies show that there is a critical window of opportunity between pre-conception and age two, during which nutrition can have a measurable and lasting impact on growth, brain development, incidence of disabilities, and susceptibility to disease or infection. The full long-term effects reach beyond health – with poor early nutrition leading to limited educational achievement and decreased lifelong economic opportunity.

A review of the associations between maternal and child undernutrition and risk of adult disease in low- and middle-income countries found that HAZ score at two years was the best predictor of human and early undernutrition was found to be associated with lower human.6

The long-term effects of stunting: Research also shows that poor growth during childhood also has important long-term consequences in adult life in terms of body size, work and reproductive performances, and risk of chronic diseases.

Shorter adult height and reduced adult income/economic productivity: Child stunting leads to significant reduction in adult size; one of the main consequences of small adult size resulting from stunting during childhood is reduced work capacity, which in turn has an impact on economic productivity. Studies show that height at two years of age is clearly associated with enhanced productivity and human capital in adulthood. Thus early nutrition is also an important contributor to economic development. There is evidence that improving growth through adequate and appropriate complementary feeding can have a significant effect on adult wages. An evaluation of one program in Latin America that provided good-quality complementary food to infants, found that the wages of males in adulthood increased by 46%, compared to peers who did not participate in the program.2

Lower attained schooling and educational performance: According to UNICEF, stunting is an important predictor of child development and is associated with reduced school outcome. Compared to children who are not stunted, stunted children often enroll later, complete fewer grades, and perform less well in school. As a consequence, this under performance leads to reduced productivity and income-earning capacity in adult life.

Greater risk of obstetric complications and decreased offspring birth weight: Short women are at a greater risk for obstetric complications because of their smaller pelvic size and possible anemia; thus stunting in childhood for women can impact on their risk of maternal mortality. Likewise, chronic undernutrition in early life, either before birth or during early childhood, can later lead to the next generation of babies being born with a low birth weight, which in turn leads to undernutrition as these babies grow older. Thus a vicious cycle of undernutrition repeats itself generation after generation. In addition, the occurrence of early pregnancy also contributes to

both low birth weight of the infant and the introduction of premature cessation of growth in the mother. The implications are enormous for the human and socioeconomic development of affected populations.

Higher risk of chronic disease in later life: There is an increased risk of chronic diseases related to nutrition in children who are undernourished in the first two years of life and put on weight rapidly later in childhood and adolescence. It is critical that interventions consider not only the prevention of undernutrition and stunting, but should also give attention to the prevention of excessive weight gain after infancy. For the development of chronic conditions such as cardiovascular disease and diabetes, the worst-case scenario is a baby of low birth-weight who is stunted and underweight in infancy, and then gains weight rapidly in childhood and adult life. This scenario is not uncommon in countries where underweight rates have been reduced, but stunting remains relatively high. This problem is further compounded by the adoption of the diets and lifestyles of developed countries.

Stunting and the MDGs: The importance of reducing childhood undernutrition has been enshrined in the United Nations Millennium Development Goals (MDGs) – a set of global time bound and quantified targets for improving the social and economic conditions of the world's poorest people. MDG1 and MDG4 recognize the role of undernutrition as an underlying cause of many child deaths – placing nutrition centrally within the MDGs. MDG1 has set a target to reduce by half the prevalence of underweight children less than five years of age by 2015. Underweight can, by definition, indicate wasting, or much more commonly, stunting. Those two conditions can have different determinants and respond to different interventions. It is therefore considered that monitoring the prevalence of both wasting and stunting is more useful than

consideration only of underweight. MDG4 has a target to reduce by two thirds the mortality rate among children less than five years of age by 2015. As stunting accounts for almost 1.5 million global deaths (14.5%) and 12.6% of disability-adjusted life years (DALYs) in children under five years of age, it has to be addressed if MDG4 is to be achieved.

While MDG1 and MDG4 are most directly related to stunting, its long-term effects are also associated with the achievement of other MDGs, including MDG2 (Achieve universal primary education) and MDG5 (Improve maternal health). Thus, without the reduction of stunting, many of the MDGs will not be met. The pivotal role of nutrition and the urgent need to focus on maternal, newborn, and under-five health and mortality was acknowledged in the September 2010 MDG summit outcome document, appropriately entitled "Keeping the promise: united to achieve the Millennium Development Goals."

Sadly, stunting is often overlooked as the children it affects may appear healthy, and nutrition remains a low priority on the national development agendas of many countries, with a lack of understanding by policy makers of how improved nutrition can contribute towards achieving national social and economic goals.

Stunting facts

• Stunting affects 34% of children under five years (approximately 195 million or one in three children). Nearly half of these children live in South Asia.

• Africa (40%) and Asia (36%) are the continents with the highest stunting rate, with more than 90% of the world's stunted children living on these two continents.

• Of the 10 countries that contribute most to the global burden of stunting among children, six are in Asia. These countries all have relatively large populations: Bangladesh, China, India, Indonesia, Pakistan, and the Philippines.

The **National Family Health Survey** (NFHS)-3 documented the prevalence of underweight, stunting, and wasting among children in Delhi as 26.1%, 42.2%, and 15.4% respectively.

A study had done by **Mostafa Kamal SM** in 2007 at Bangladesh to assess the effect of the socio-demographic variables on moderate and severe stunting over normal among the children. Results showed over two-fifths of the children were stunted, of which 26.3% were moderately stunted and 15.1% were severely stunted. The multivariate multinomial logistic regression analysis yielded significantly increased risk of severe stunting (OR=2.53, 95% CI=1.34-4.79) and moderate stunting (OR=2.37, 95% CI=1.47-3.83) over normal among children with a thinner mother. Region, father's education, toilet facilities, child's age, birth order of children and wealth index were also important determinants of children's nutritional status.

Reynaldo Martorell et al. investigated the causes of stunting and wasting using nationally representative data on preschool children from India (2005–2006, N =41,306) and Guatemala (2008–2009, N = 10,317). They estimated stunting and wasting using the 2006 WHO standard and the 1976 WHO/National Center for Health Statistics (NCHS) reference. India and Guatemala had high levels of stunting; wasting was common in India but rare in Guatemala. Use of the WHO standard (based on breast-fed children) increased the prevalence of stunting in both countries but dramatically changed the pattern of wasting by age in India. They showed that household wealth and the condition of women were related to both stunting and wasting; review of the literature on wasting failed to identify factors that were not also related to stunting (e.g., seasonality, infections, and intrauterine growth retardation).

A community-based cross-sectional study of child nutritional status was carried out in 14 flooded and 18 non-flooded villages of Jagatsinghpur district (Orissa) within one month of the September

2008 floods, and similarly affected by flooding in August 2006 by **Jose Manuel Rodriguez-Llanes et al.** Study analyses revealed that children in flooded households were more likely stunted compared with those in non-flooded ones (adjusted prevalence ratio 1.60; 95% CI 1.05 to 2.44). The prevalence of underweight was also higher in children living in the flooded communities (adjusted prevalence ratio 1.86; 95% CI 1.04 to 3.30). Further analyses found that the 26-36-month flooded cohort, thus those children younger than 1 year during the precedent flood in August 2006, attained the largest difference in levels of stunting compared with the unexposed group of the same age.

Darteh *et al*.*had conducted* a cross sectional survey in Ghana. A total of 2379 children under five years who had valid anthropometric data were used for the study. Data on the stunting of children were collected by measuring the height of all children less than six years of age. Measuring board produced by Shorr Productions was used to obtain the height of the children. Children less than 2 years of age were measured lying down on the board while those above 2 years were measured standing. In the DHS data, a z-score is given for the child's height relative to the age. Both bi-variate and multi-variate statistics are used to examine the correlates of stunting. The study result revealed Stunting was common among males than females. Age of child was a significant determinant of stunting with the highest odd of stunting been among children aged 36–47 months. Region was significantly related to stunting.

Children from the Eastern Region were more likely to be stunted than children from the Western Region which is the reference group (OR = 1.7 at $p < 0.05$). Number of children in household was significantly related to stunting. Children in households with 5–8 children were 1.3 times more likely to be stunted compared to those with 1–4 children ($p < .05$). Mother's age was a

significant predictor of stunting with children whose mothers were aged 35–44 years being more likely to be stunted.

A study in Bangladesh in 2011 had done by **Md. Nure Alam siddiqui et al**. and results showed the high prevalence of stunting and underweight, for instance 42% and 40% of under-five children were stunted and underweighted respectively. The analyses of the study also revealed that household economic status, mother's education, father's education, mother's antenatal visit (s), mother's age at birth and mother's BMI are the most significant factor /determinant s of child's malnutrition.

Olack B *et al.* investigated food insecurity due to post-election violence resulted in high prevalence of acute and chronic malnutrition in children, a nutritional survey was undertaken among children aged 6-59 months within two villages in Kibera. Results showed that Stunting was found in 47.0% of children; 11.8% were underweight, and 2.6% were wasted. Severe stunting was found in 23.4% of the children; severe underweight in 3.1%, and severe wasting in 0.6%. Children aged 36-47 months had the highest prevalence (58.0%) of stunting while the highest prevalence (4.1%) of wasting was in children aged 6-11 months. Boys were more stunted than girls ($p<0.01$), and older children were significantly ($p<0.0001$) stunted compared to younger children. In the third year of life, girls were more likely than boys to be wasted ($p<0.01$).

In Indonesia; **Ramli et al** had conducted a study in 2004 using a cross-sectional multi-stage survey on 750 households from each of the four island groups in North Maluku province Prevalence of stunting and severe stunting were 29% (95%CI: 26.0-32.2) and 14.1%(95%CI: 11.7-17.0) for children aged 0-23 months and 38.4% (95%CI: 35.9-41.0) and 18.4%

(95%CI:16.1-20.9) for children aged 0-59 months, respectively. After controlling for potential confounders, multivariate analysis revealed that the risk factors for stunted children were child's age in months ,male sex and number of family meals per day (≤2 times), for children aged 0-23 months, and income (poorest and middle-class family), child's age in months and male sex for children aged 0-59 months. The risk factors for severe stunting in children aged 0-23 months were income (poorest family), male sex and child's age in months and for children aged 0-59 months were income (poorest family), father's occupation (not working), male sex and child's age in months.

To assess prevalence of malnutrition and associated factors among children aged 6-59 in 2012; **Mengistu K, et al** was conducted a community based cross sectional study on 820 children aged 6-59 months from September 8-23, 2012 at Hidabu Abote district. Multistage sampling method was used to select households. Children were selected from each kebeles by simple random sampling. The analysis this study revealed that, 47.6%, 30.9% and 16.7% of children were stunted, underweight and wasted, respectively. The main associated factors of stunting were found to be child age, family monthly income, and children were received butter as pre-lacteal feeding and family planning. Underweight was associated with number of children HHs and children were received butter as per-lacteal feeding. Treatment of water in HHs the only variable associated with wasting.

A study was done by **Janevic et al** to elucidate risk factors for malnutrition in children in Roma settlements in Serbia. In this study, Anthropometric and socio-demographic measures were obtained for 1192 Roma children under five living in Roma settlements from the 2005 Serbia Multiple Indicator Cluster Survey. Multiple logistic regressions were used to relate family and

child characteristics to the odds of stunting. In analysis, the prevalence of stunting was 20.1%. Nearly all of the children studied fell into the lowest quintile of wealth for the overall population of Serbia. Children in the lowest quintile of wealth were four times more likely to be stunted compared to those in the highest quintile, followed by those in the second lowest quintile (AOR = 2.1) and lastly by those in the middle quintile (AOR = 1.6). Children who were ever left in the care of an older child were almost twice as likely to stunt as those were not. This study was a suggestion that maternal, but not paternal, education was associated with stunting. Whether children were ever breastfed, immunized or had diarrhea episodes in the past two weeks did not show strong correlations to children malnutrition status in this Roma population.

AIM:

To assess the prevalence & associated risk factors related to stunting in rural community of Jaipur district

OBJECTIVES:

To estimate the prevalence of stunting in rural community by using cross sectional cluster random sampling method

To examine the relationship between child, mother & environmental risk factors and prevalence of risk factors

To suggest corrective action to strengthening of nutritional programme.

METHODOLOGY

Study Site

The study will be carried out in rural community in Jaipur block, Rajasthan state, Jaipur District. The district has 1481 villages & the rural population 3,154,331 according to census 2011. The under six year comprise 14.7% of the total rural population. Health services are delivered at grass root level through 4 medical college, 28 community health centres (CHC), 119 Primary health centres (PHC) & 616 sub-health centres (SC) in Jaipur District [13]. There are 9 blocks in Jaipur district. One of the blocks Sanganer which have 25 gram panchayat, in the district will be randomly selected, for the present study PHC (gram panchayat) Dadhiya constituting a population of around 40,000 comprising of 36 villages will be randomly chosen. Among 36 villages there are eighteen villages will be shortlisted using PPS (Probability proportion to size) technique from each selected village a cluster i.e. the household will be selected using SRS (simple random sampling) technique thus resulting in a total 20 clusters selection so a total 360 household will be selected.

Sampling Size-

According to NFHS3, prevalence stunting of is 45% & CI is 95%, and confidence level 5%, population 24000, and considering design effect 1.5, the sample size is 512.
It is estimation of sample size.

$n=Z^2_{1-\alpha/2}P(1-P)/D^2$

Ethical consideration and study inclusion and exclusion criteria

As the study involves human participants, the study will sort ethical approval from the Institute

of Health Management Research (IIHMR University) Institutional Review Board (IRB). Only those who are willing to participate and give written informed consent will be part of this study. The study will maintain the privacy and confidentiality of the study participants. As per study objectives, the study will include only mothers with children aged 6-59 months will be included in the study. If child would be found stunt we will inform to parents regarding the nutrition status and give the appropriate nutrition education, information about Anganwadi Nutrition supplementation and Mid-day Meal Program in School and give them referral slip for consult to the nearest PHC or CHC Medical officer or LHV/Paramedical staff.

Sampling procedure

The present study is a cross sectional study. The study populations comprise children aged 6-59 months and their caretakers. Multistage sampling procedure will be adopted to select sub block, primary health centers (PHC), village and finally the households. There are 9 blocks in Jaipur district. One of the blocks Sanganer which have 25 gram panchayat, in the district will be randomly selected, for the present study PHC (gram panchayat) Dadhiya constituting a population of around 40,000 comprising of 36 villages will be randomly chosen. Among 36 villages there are eighteen villages will be shortlisted using PPS (Probability proportion to size) technique from each selected village a cluster i.e. the household will be selected using SRS (simple random sampling) technique thus resulting in a total 20 clusters selection so a total 360 household will be selected. Modified WHO cluster sampling technique will be used to select study households and participants. In the select village a borehole would be considered as the center of the cluster/zone. To determine the direction of movement, the camp leader spun a pen.

The direction would be pointed by the tip of the pen will be followed. The households in the direction the pencil pointed (from the centre to the end of the cluster) will be allocated numbers. To determine the starting point (household) random selection would be made.

In each select household, the parents/caretakers would be interviewed to obtain information about their children aged 6 – 59 months. Anthropometric measurements (weight and height) will be taken, and the children aged 6-59 months will also examine for edema. If more than one child between the ages of 6 months to 59 months will be found in the same household, then one of them will be randomly selected. The child selected would be referred to as an index child. If the index child will be from a multiple birth (twin or triplet), then both or all the children of that birth would be assessed in order to conform to the cultural practices. The next household chosen for the interview will the one whose door will nearest to the previous household in which the interview has been conducted. A household with no child under five years of age will skip.

Anthropometric measurements (weight and height) - Depending on a child's age and ability to stand, measure the child's length or height. A child's length is measured lying down (recumbent). Height is measured standing upright.

- If a child is less than 2 years old, measure recumbent length.

- If the child is aged 2 years or older and able to stand, measure standing height.

In general, standing height is about 0.7 cm less than recumbent length. This difference was taken into account in developing the WHO growth standards used to make the charts in the Growth Record. Therefore, it is important to adjust the measurements if length is taken instead of height, and vice versa.

- If a child less than 2 years old will not lie down for measurement of length, measure standing height and add 0.7 cm to convert it to length.

-If a child aged 2 years or older cannot stand, measure recumbent length and subtract 0.7 cm to convert it to height.

Equipments- A. Infantometer-Equipment needed to measure length is a length board which should be placed on a flat, stable surface such as a table. To measure height, use a height board (sometimes called a stadiometer) mounted at a right angle between a level floor and against a straight, vertical surface such as a wall or pillar. B.Height board-A good length or height board should be made of smooth, moisture-resistant (varnished or polished) wood. The horizontal and vertical pieces should be firmly joined at right angles. A movable piece serves as the footboard when measuring length or the headboard when measuring height. Ensure that the height board is on level ground. Check that shoes, socks and hair ornaments have been removed. C. Weight machine/Baby weight machine- For both children and women.

Procedure- Working with the mother, and kneeling in order to get down to the level of the child:

-Help the child to stand on the baseboard with feet slightly apart. The back of the head, shoulder blades, buttocks, calves, and heels should all touch the vertical board. This alignment may be impossible for an obese child, in which case, help the child to stand on the board with one or more contact points touching the board. The trunk should be balanced over the waist, i.e., not leaning back or forward.

- Ask the mother to hold the child's knees and ankles to help keep the legs straight and feet flat, with heels and calves touching the vertical board. Ask her to focus the child's attention, soothe the child as needed, and inform you if the child moves out of position.

- Position the child's head so that a horizontal line from the ear canal to the lower border of the eye socket runs parallel to the baseboard. To keep the head in this position, hold the bridge between your thumb and forefinger over the child's chin.

- If necessary, push gently on the tummy to help the child stand to full height.

- Still keeping the head in position use other hand to pull down the headboard to rest firmly on top of the head and compress the hair.

- Read the measurement and record the child's height in centimeters to the last completed 0.1 cm in the Visit Notes of the Growth Record. This is the last line that can actually see. (0.1 cm = 1 mm)

Remember: If the child whose height you measured is less than 2 years old, add 0.7 cm to the height and record the result as length in the Visit Notes.

Values of the reference median (<median – 2 SD) 'height-for-age' indices will be classified as stunting, while children who will below three SD values of the reference median (<median – 3 SD) will classified as 'severe stunting'.

Statistical Analysis

Pertaining to establish/associate risk factors for stunting qualitative and quantitative information on Demographic, Socioeconomic, Environment and Sanitation was drawn and data will be

properly categorised using metric and ordinal scale measurements. Z-scores have been calculated using the WHO/CDC/NCHS references. So Stunting will be defined as height-for- age Z-score < -2 [4]. Covariates will be selected based on previous literature, and would be categorized after examining their frequencies. Base on objectives of our study descriptive and inferential statistics would be drawn for prominent continuous variables & linear regression technique will be applied to obtain estimates of the predictors of each Stunting outcome controlling for the effects of the other predictors. For categorical variables, logistic regression approach using a probit model in STATA V.12.0 will be used and the outcomes would be compared using odds ratio (O.R).

ANALYSIS-

Table 1-Descriptive characteristics of socio-demographic variable (N=512)

Characters	N	%
Sex of children		
Male	248	48.4
Female	264	51.6
Age of children (months)		
6-12	110	21.6
13-36	272	53.2
37-59	130	25.2
Type of Family		
Nuclear	292	56.9
Joint	89	17.3
Ext. Nuclear	132	25.8
Family size		
1-4	189	36.9
4-9	287	56.0
10 or more	36	7.1
Religion		
Hindu	470	91.9
Muslim	42	8.1
Caste		
General	57	11.1
OBC	215	41.9
ST/SC	240	47.0
Type of House		

Kutcha	188	36.7
Semi Pucca	146	28.6
Pucca	178	34.7
Literacy status of Mother		
Illiterate	354	69.2
Literate	158	30.8
Literacy status of Father		
Illiterate	160	31.3
Literate	352	68.7
Working Status of Mother		
Working	106	20.8
Not Working	406	79.2
Occupation of Father		
Skilled Worker (Govt or Private Job, Business)	137	26.8
Unskilled Worker	375	73.2
Monthly Family Income		
Up to 5000	227	44.4
5001 to 10000	197	38.5
>10000	88	17.1

Table 2: Linear regression analysis for predictors of weight-for-height z-scores for prominent continuous variables among children aged 6-59 months (n-512)

Variable	Stunting Coeff [95% CI]
Child Level Factors	
Age of baby	-0.58[-0.72, -0.41]**
Birth Weight	3.14 [1.15, 5.09]**
Birth Interval	-0.03[-0.06, 0.02]
Birth Order	0.47[-0.44, 1.45]
Exclusive Breast Feeding	-0.44[-0.80, -0.03]*
Maternal Factors	
ANC	0.34[-0.31, 0.97]
PNC	-1.69[-0.78, 0.45]
Household Factors	
Family size	-0.26[-0.63, 0.17]
Family monthly Income	0.0003[0.00005, 0.0002]**

*=p<0.05; **=p<0.005; ***=p<0.0005

Table 3a: Logistic regression analysis for prominent Maternal and Child level factors with Stunting.

Variable	Stunting OR [95% CI]
Child Level Factors	
Exclusive Breastfeeding	
>6months	1
<6months	1.34[0.85, 2.27]
H/o of Morbidity	
No H/o of morbidity	1
H/o morbidity	1.39[.84, 2.17]
Maternal Factors	
ANC care	
4 or more visits	1
3 or less visits	1.69[1.20, 2.49]*
BMI of mother	
Normal	1
Underweight	1.08[0.73, 1.53]
Overweight	2.17[0.79, 5.58]
Type of delivery	
Term	1
Pre-term	1.79[0.89, 3.55]

Table 3b Logistic regression analysis for Household, Environmental and Sanitation level factors with

Type of family	Stunting (OR 95 CI)
Nuclear	1
Joint	1.35[0.84, 2.24]
Ext. Nuclear	
Food	
Vegetable	1
Non –vegetable	1.09[0.75, 1.58]
History of TB in Family	
No.	1
Yes	4.89[1.35, 17.33]*
Exposure to Media	
No	1
Yes	0.670.43, 0.99]*
Type of House	
Kutcha	1
Pucca	0.54[0.32, 0.87]**
Semi-Pucca	0.48[0.29, 0.65]***
Over-crowding	
No	1
Yes	2.5[1.11, 4.37]*
Safe Water supply	
Hand pump	1

Other source	2.18[1.36, 3.45] **
History of mud eating	
No	1
Yes	1.47[0.79, 2.69]
Umbilical Cord Application	
No	1
Yes	1.46[0.79, 2.48]
Place of Defecation	
Closed	1
Open air	3.08[1.68, 5.37]
Water Purification	
No	1
Yes	1.27[0.52, 2.95]
Hospital	1
Home	1.19[0.62, 2.27]
IFA	
Yes	1
No	1.29[0.75, 2.16]
Any illness during pregnancy	
No	1
Yes	2.88[1.33, 3.19]*
Working status of mother	
Working	1.77[1.04, 2.63]*
Not working	1
Gender of child (OR)	

Male	1
Female	1.68[1.00, 2.57]*
Literacy status of Mother	
Illiterate	2.57[1.15, 5.66]*
1st to 5th Class	1.18[0.49, 2.79]
6th to 8th Class	2.25[1.19, 4.33]*
≥ 9th Class	1

*=p<0.05; **=p<0.005; ***=p<0.0005

RESULTS

Coverage particulars and socio-demographic profile of study subjects (Table 1)

A total of 512 children were covered, of which 21% were below 1 year and 53.2% were 1-3 years of age. There were equal numbers of male (48.4%) population as compared to females (51.6%). The mean age of under-five child was almost (29.5±14.5) thirty months. Majority (92%) of the households were Hindus, and about one thirds (36.7%) were living in *Kutcha* houses, while 28.6% were living in semi *Pucca* houses. Fifty seven percent of the households were nuclear families, while 17% were joint families. The average family size was 5.74 (±2.36). Illiteracy rate was much (69.2%) higher among females than males (31.3%). Almost three fourth (73%) male population and less than one fourth (20%) female population were engaged in either agriculture or non-agriculture labour work (Table 1). Safe water was accessible to only 4.5% of the families and nearly all the houses were using firewood & cow dung (96%) for cooking.

Sanitary latrine was present only in 13%, while overcrowding was common norm for majority (92%) of the families.

Nutritional status of children under 6months to 5 years

Prevalence of overall stunting was about 54%, and of them, about 2.2% were severely stunted.

Nutritional status by age groups, gender and socioeconomic and demographic variables

Linear regression analysis (Table 2) was used for predictors of weight-for-height and it was observed that stunting was positively associated with birth weight, birth order, ANC visit at health care facilities & family monthly income while negatively associated with age of baby, birth interval, EBF, PNC visit at health care facilities, & family size. Statistically significant association was observed for stunting with age of baby, birth weight, EBF & family monthly income variables.

Logistic regression analysis (Table 3) was used to identify significant association between stunning socio-economic, environment, demographic, maternal and child health variables.

Analysis of this study showed that stunting was 1.68 time more in female than in male child (OR=1.68; Cl=1.00-2.57). There was 1.69 time increase the risk of stunting among those had received 4 or more ANC visits service (OR=1.69; Cl=1.20-2.49) as compared to whose mother received less than 4 ANC services at health care facilities during pregnancy. The risk of stunting was about thrice (OR=2.88;Cl=1.33-3.19) among children whose mother had any type of severe illness during pregnancy as compared those children whose mother did not had any type of illness during pregnancy. Illiteracy plays a vital role in promoting stunting the risk was 2.57 (1.15-5.66) and 2.25 (CI=1.19-4.33) times higher among children whose mothers were illiterate

and those educated up to 8th standards, as compared to children whose mothers were educated to the level of higher secondary and above. There was fourfold increase risk of stunting among whose family had TB case (OR=4.89; Cl=1.35-17.33) as compared to whose family did not have TB case. Analysis of this study showed that children from those family who had access to Mass media were about 0.6 times less likely to be stunted as compared to those children who come from family without access to any type of Mass media (OR=0.67; Cl=0.43- 0.99). Children living in overcrowded families had a two time risk (2.5; CI=1.11- 4.37) of being stunted as compared to children from non-overcrowded families. (Table 3)

Children belonging to families to those living in Pucca and Semi-Pucca houses had 0.54 (CI=0.32-0.87) & 0.48 (CI=0.29-0.65) times lower risk of stunting as compared to children belonging families to those living in Kutcha houses. Risk of Stunting was twice in children (OR=2.18, Cl=1.36-3.45) belong to those houses where water supply through hand pump as compared to houses where water supply through other method. Children whose mother's workings were 1.7(OR=1.77; Cl=1.04-2.63) more likely to be stunted as compared to those mothers were housewife.

DISCUSSION

A number of programmes were implemented to improve the nutritional status of the population in the second half of the last century. Large amounts of resources were spent on food subsidy programmes and also on food distribution activities for women and children (38). A nutritional surveillance system was introduced at Anganwadi centers. There have been marked improvements over the past few decades in the nutritional status of children (38, 39). However, much work remains to be done (38). We did not find any evidence of significant collinearity in

our study. However, certain inherent limitations may arise in the study such as the difficulty to examine temporal relationships, differences in seasonal distribution of risk factors, recall bias, absence of data on maternal nutrition and food practices of the family, absence of data on parasitic infections, absence of comprehensive data on mental health of the family including different psychosocial stimulation and/or interaction between family members, and the possibility that respondents would answer in more socially desirable ways.

In South and South-East Asia, India is the only country with a higher prevalence of under-nutrition in rural areas (underweight 43%, stunting 48% and wasting 20%). Neighbor countries, such as Nepal (stunting 49%), and Bangladesh (stunting 43%) had similar prevalence of under nutrition in rural areas while prevalence of stunting lower in Pakistan (stunting 37%) [40]

In the present study, the prevalence stunting was 54% while high prevalence (67.8%) stunting was reported in a study conducted on Saharia tribe population of Rajasthan by Rao *et al* [41]. The findings of this study shows rural residence as a determinant of child malnutrition which was in accordance with several other studies [41, 42, 43]. Stunting is known to be more prevalent in rural areas (44). People living in rural areas are provided with less access to health services, education and other social support systems which are either more available or easily accessible to residents in urban areas.

In the current study, being from the less privileged groups was a risk factor initially but disappeared in subsequent multivariate analysis. The effects of income are known to be mediated through other underlying determinants (45, 46). These factors determine the ability of the family to combine their knowledge, resources and patterns of behavior, to promote, recover or maintain

health status and to cope with a difficult environment (45, 46, 47). Such factors include parental education, psychosocial stimulation and household environment (45–48).

The present study showed the negative association of age of baby with stunting, Higher prevalence of under nutrition among early age of children might be due to faulty feeding practices such as untimely initiation of complementary feeding, non-exclusively breast feeding up to first six months and high prevalence of infections such as diarrhea, ARI, worm infestation in this age group.

Inequity-driven health and education service expansion in India, stunting was related to living in rural areas. Gender is an important aspect of equity. The prevalence of stunting in current study was higher among girls than established boys; the cause of this discrepancy is might be due to gender-centric discrimination in early childhood & negative family and community attitudes towards the girl child.

In the current study, paternal education and age were significant factors associated with stunting in the current study. Higher education could reflect higher income and more paternal interest in child nutrition. More educated fathers are more likely to have educated wives. Educated mothers are known to be older at their first birth and are more knowledgeable about care practices. Educated families live in smaller households, in better houses, they are better able to use health-care facilities, and are more adept at keeping their environment clean (49-51). Logistic regression revealed that Stunting was significantly higher among children whose mothers were illiterate or had primary or upper primary education compared with children whose mothers were educated (Higher secondary and above). Higher level of maternal education leads to efficient management of limited household resources, optimum utilization of modern health care services,

better health promoting behavior, as well as change in traditional beliefs about diseases causation, and use of contraceptives for birth spacing and more child-centered caring practices [51-52].

Low family income results in lower literacy rate, low purchasing capacity and thus accelerating food insecurity resulting higher under nutrition rates. Present study explores a directly proportional relationship between income of a family to its nutritional status and one can say household per capita income is the indicators for socio-economic development and observed to be associated with stunting. Similar observations were quoted by other authors too [52, 53, 54]. Although the economic differentials seem to be silent in rural society it appears to be an important predictor of childhood nutritional status which can't be ignored. Low income also increases the likelihood of infection through inadequate personal and environmental hygiene mechanisms [52, 53, 54].

Consistent with many other studies [54, 55], the multivariate analysis of this study revealed that mother's BMI is positively associated with nutritional status of children. Higher the BMI, lower the risk of being stunting over normal BMI, which is consistent with previous studies conducted elsewhere (Bell *et al*., 2007). This study showed that underweight mothers have a greater risk of their children being malnourished. A healthy mother can have healthy children. Children of well-nourished mothers had a lower risk of being stunted compared to children of undernourished mother. Similar results also observed by other authors. [54, 55]

Antenatal care, the care a woman receives throughout her pregnancy, is important in determining child nutritional status. Lowest risks of stunted children were found among mothers having

complete antenatal care visits. Results of this study show that there is a significant association between mother's antenatal care visit and child nutritional status.

Environmental factors refer to the availability of safe water, sanitation and environmental safety, including shelter. Environmental factors such as poor housing and exposure to untreated water are known to be associated with stunting (56, 57). In fact, most of the positive effect of income on child height could be mediated by the quality of family housing (56, 57) .Present study showed that, children from families not treating their drinking water by boiling, straining through cloth and bleaching/chlorine were more likely to be affected by wasting as compared to children were from families treating their drinking water. This finding similar to study conducted western Kenya showed that, more children who drank water that was not consistently treated in households were wasted [52, 53, 54]. Therefore, diarrhea and water born diseases caused by unsafe drinking water at households' level might increase the prevalence of malnutrition directly or indirectly. Such water may be either contaminated, thereby predisposing children to repeated bouts of infection, or lacking in some micronutrients, which might compromise growth. Having piped water in the home also reflects higher income levels and/or that the environmental sanitation in these homes is better. When water is not readily available, food hygiene is frequently poor, which increases the risk of pathogen contamination and exposure to illnesses. However, the fact that storing water in tanks protects against infections in comparison to publicly supplied piped water calls for better quality control of this system.

Breast milk contains the mix of nutrients that is best suited to the infant's metabolism. An initial period of exclusive breast-feeding is essential to lower the risk of stunting, after which supplementary foods should be introduced appropriately into the child's diet (55). The use of

bottle feeding predisposes to infections and may be associated with diluted non-nutritive formula preparation (55). Early introduction of complementary foods is a known predictor of undernutrition (54), but there is a debate as to the most suitable age that supplements should be first given (53). In the current study, breast-feeding was considered optimal if it started early, if it was continued for 12 months and if weaning started at 6–8 months. It was considered appropriate if weaning started earlier (between 4 and 6 months). In the current study, optimal breast-feeding was not as protective as appropriate breast-feeding. In addition, there was a protective effect of bottle feeding and early introduction of breast milk substitutes such as powder milk or pasteurized bottled milk. Previous studies reported a similar observation where, for example, longer breast-feeding was associated with both higher stunting and severe stunting risk (54). This should be viewed as failure of optimal complementary feeding and the inability of the household to provide supplemental foods, and should not be an argument for advertising of these substitutes (55). In other cases, when a child is severely stunted, mothers may respond by a decision to continue breast-feeding. Moreover, none of the dietary intake factors in the current study persisted in the multivariate model.

Children living in overcrowded families are found to be at greater risk of stunting, a finding supported by other studies [31]. This could be attributed to the facilitated spread of infections such as ARI and diarrhea in overcrowded families however some studies observed a protective effect of family size for under nutrition [21, 23, 32].

Apart from the above factors associated with stunting, other factors such as type of delivery (pre-term/term), place of delivery (institutional or home), type of family, supplementation of IFA tablet during pregnancy, food habits, occupation of father, applicant on cord, vegetarian or non-

vegetarian, availability of toilet facilities in house, & family size, are all important determinants of under nutrition that needs further study to explore their association.

CONCLUSION

To fight under-nutrition sustainably, changes in many of the underlying factors are necessary. In spite of the existence of food security programmes in India, the broader concept of nutritional security should be implemented. The current study provides relevant information for determining courses of action to be taken at the meso and micro level to improve the nutrition and health of children in India. Policy frameworks must be established that incorporate short-, medium- and long-term strategies to solve nutritional problems in India. Corresponding intervention strategies should be comprehensive, culturally sensitive and addressed at various levels. Programmes should specifically target higher-risk groups such as young children, residents of rural community, less educated fathers, poor family social life, low-quality household environment, various morbidity and low birth weight. Particular attention should be given to the particularly brief window of intervention from the mother's pregnancy through the child's first two years of life. Further research, particularly on regional differences, is required to design relevant and effective intervention programmes.

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